

OPTON MEMORIAL LIBRARY
THE OHIO STATE UNIVERSITY
105 S. OVAL DRIVE

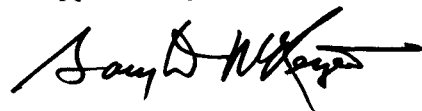
Senior Thesis

Geology of The Ohio State University, Columbus Campus

By
Tyler D. McMillan
1999

Submitted as partial fulfillment of
The requirements for the degree of
Bachelor of Science in Geological Sciences
At The Ohio State University,
Spring Quarter, 1999

Approved by:



Dr. Garry McKenzie

Senior Thesis

1999

McMillan

Table of Contents

	Page
INTRODUCTION	1
Purpose of the Study	1
Location, Topography, and Geology	1
GEOLOGY AND GEOLOGIC HISTORY OF FRANKLIN COUNTY	3
Quaternary	3
Kansan (Pre- Illinoian) Glaciation	6
Illinoian Glaciation	7
Wisconsinan Glaciation	7
Paleozoic	11
Geologic History	11
Columbus Limestone	11
Delaware Formation	13
Ohio and Olentangy Shale	13
UNCONSOLIDATED MATERIALS OF OSU CAMPUS	14
Glacial and Post-glacial Deposits	14
Soils of the OSU Campus	14
CsB Crosby-Urban land complex	16
CrB Crosby silt loam	18
Ko Kokomo silty clay loam	18
Ut Udenthents-Urban land complex	18
CfB Celina-Urban land complex	19
MnC Miamian-Urban land complex	19
EmB Eldean-Urban land complex	20
Rs Ross silt loam	20
Uw Urban land-Genesee complex	21
Ux Urban land-Ockley complex	21
Uv Urban land-Celina complex	22
HYDROGEOLOGY OF THE OSU CAMPUS	22
Groundwater in the Consolidated Rocks	22
Groundwater in Surficial Aquifers	23
STRATIGRAPHY OF THE SURFICIAL DEPOSITS OF THE OSU CAMPUS	23
CONCLUSION	30

List of Figures

	Page
Figure 1 Physiographic diagram of Ohio (from Schmidt and Goldthwait, 1950)	2
Figure 2 Bedrock geologic map and cross section of Ohio (Ohio Geological Survey, 1995)	4
Figure 3 Glacial deposits map of Ohio (Ohio Geological Survey, 1997)	5
Figure 4 Bedrock topography and flow directions of pre-glacial and glacial rivers and streams (from Schmidt and Goldthwait, 1958)	9
Figure 5 Glacial geology map of Franklin County and adjacent area (from Pavey et al., 1999)	10
Figure 6 Bedrock geologic map of Franklin County (from Schmidt and Goldthwait, 1958)	12
Figure 7 Glacial and alluvial deposits map of Franklin County (from Schmidt and Goldthwait, 1958)	15
Figure 8 Soils map of the OSU campus (from McLoda and Parkinson, 1976)	17
Figure 9 Cross Sections of Franklin County (from Schmidt and Goldthwait, 1958)	24
Figure 10 Location map, OSU Campus	26
Figure 11 East-West cross section, OSU Campus	27
Figure 12 North-South cross section, OSU Campus	28
Figure 13 Campus cross section explanation of symbols	29

INTRODUCTION

Purpose of the study

The intended result of this thesis is to bring together a comprehensive geologic report of The Ohio State University Campus area. The aspects discussed are the geology, geologic history, soils, bedrock, groundwater of the region, and surficial stratigraphy based on the borehole data. The information used was collected from a wide range of sources. The drill hole data for the cross sections of The Ohio State University (OSU) campus were collected from the Office of the University Architect and physical planning. The office is currently located at the 4th floor, Central Classroom Building, 2009 Milliken Road, on campus. Ohio Division of Geological Survey Bulletin No. 44 (Stout et al., 1943) and the Geologic Atlas of the United States Columbus Folio Ohio (Hubbard, Stauffer, Bownocker, Prosser and Cumings, 1915) reveal much information about Franklin County and its geologic history. Information on groundwater for the region was taken from The Groundwater Resources of Franklin County Ohio (Schmidt and Goldthwait, 1958). Background in almost all aspects was drawn from the many pamphlets; maps and facts sheets supplied by the Ohio Division of Geological Survey Offices in Columbus. Soils information was collected from the Soil Survey of Franklin County, Ohio.

Location, Topography, and Geology

The Ohio State University campus is located in the central region of Franklin County (Figure 1) within the city of Columbus. In the northeast corner of the OSU Oval, which is the heart of the campus, is the latitude stone which contains the position N 40

THE GROUND-WATER RESOURCES OF FRANKLIN COUNTY, OHIO

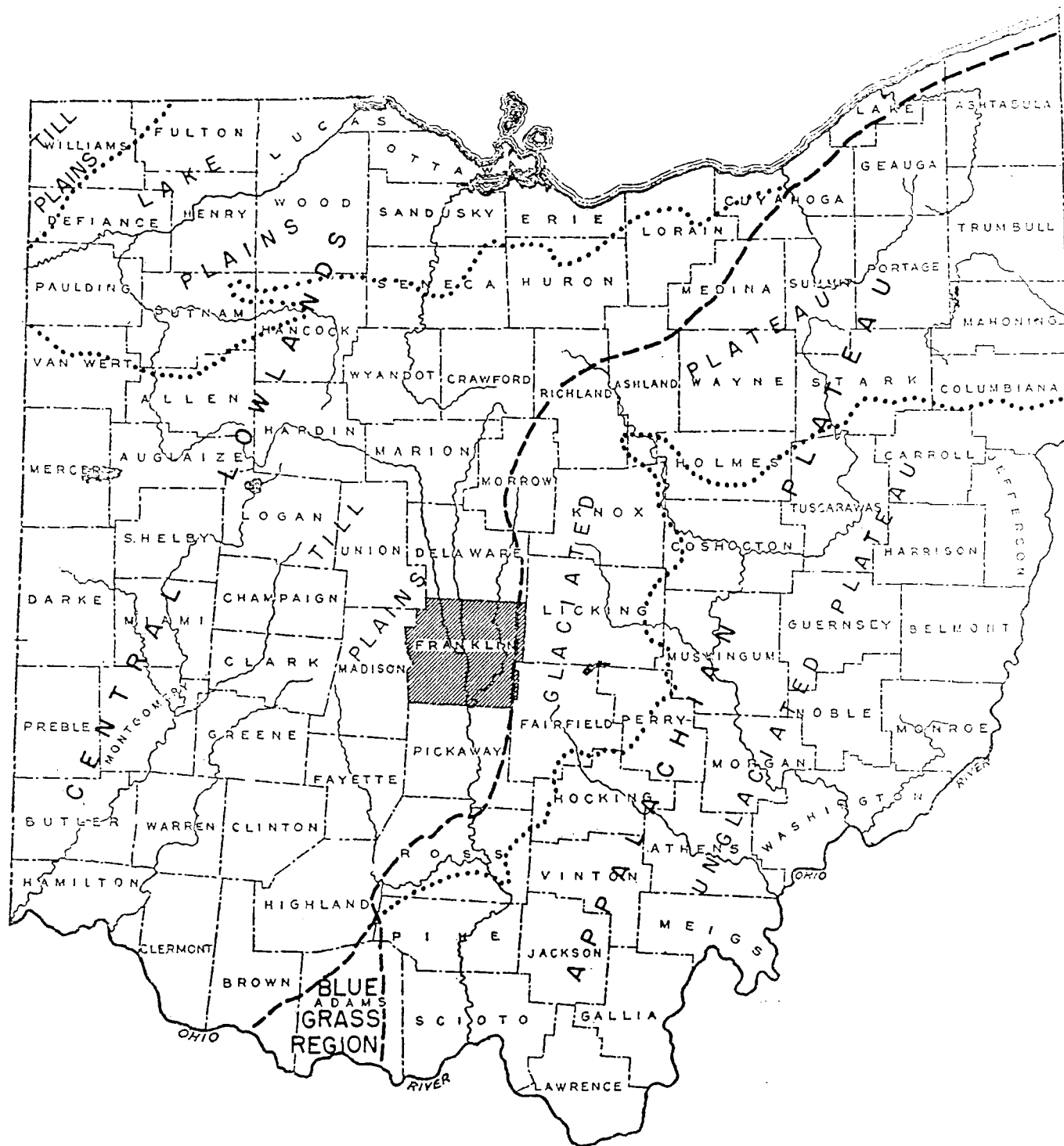


Figure 1 Physiographic diagram of Ohio (from Schmidt and Goldthwait, 1950)

00° 00'' and W 83° 00' 54''. The campus covers approximately 324,800. The Olentangy River splits the Main Campus from the West Campus. The bedrock is Devonian limestone and shale (Figure 2). The campus was affected by at least two glacial events, Illinoian and Wisconsinan (Figure 3). Topographic relief is about 60 feet with the highest elevations (about 780 feet) on West Campus and the lowest adjacent to the Olentangy River. In discussing the geology of The Ohio State University, it is necessary to look at the County, the State and in some cases the region. Franklin County is in the central part of the state (Figure 1) mainly in the Till Plains Section of the Central Lowland physiographic province. The eastern margin of the county is in the Glaciated Plateau Section of the Appalachian Plateau Province.

GEOLOGY AND GEOLOGIC HISTORY OF FRANKLIN COUNTY

Quaternary

Franklin County has been subjected to at least two glacial events. The glaciers during these events originated in central Canada and flowed south from Lake Erie over the county. They left deposits of clay, silt, sand and material of boulder size. The glaciers left material by two modes of deposition. This glacial debris was either deposited in the form of till, directly from the ice, or as kames, eskers, and outwash washed and deposited by meltwater. Till is deposited at the bottom of the advancing ice sheet or at the edges in the form of moraines. Kames and eskers are formed by deposition of sorted debris from melt water in contact with ice. Outwash is deposited from rivers and fills many valleys. As a result, these deposits are ice marginal. During the time the ice from Canada occupied Ohio, glacial lakes were common. The first

GEOLOGIC MAP AND CROSS SECTION OF OHIO

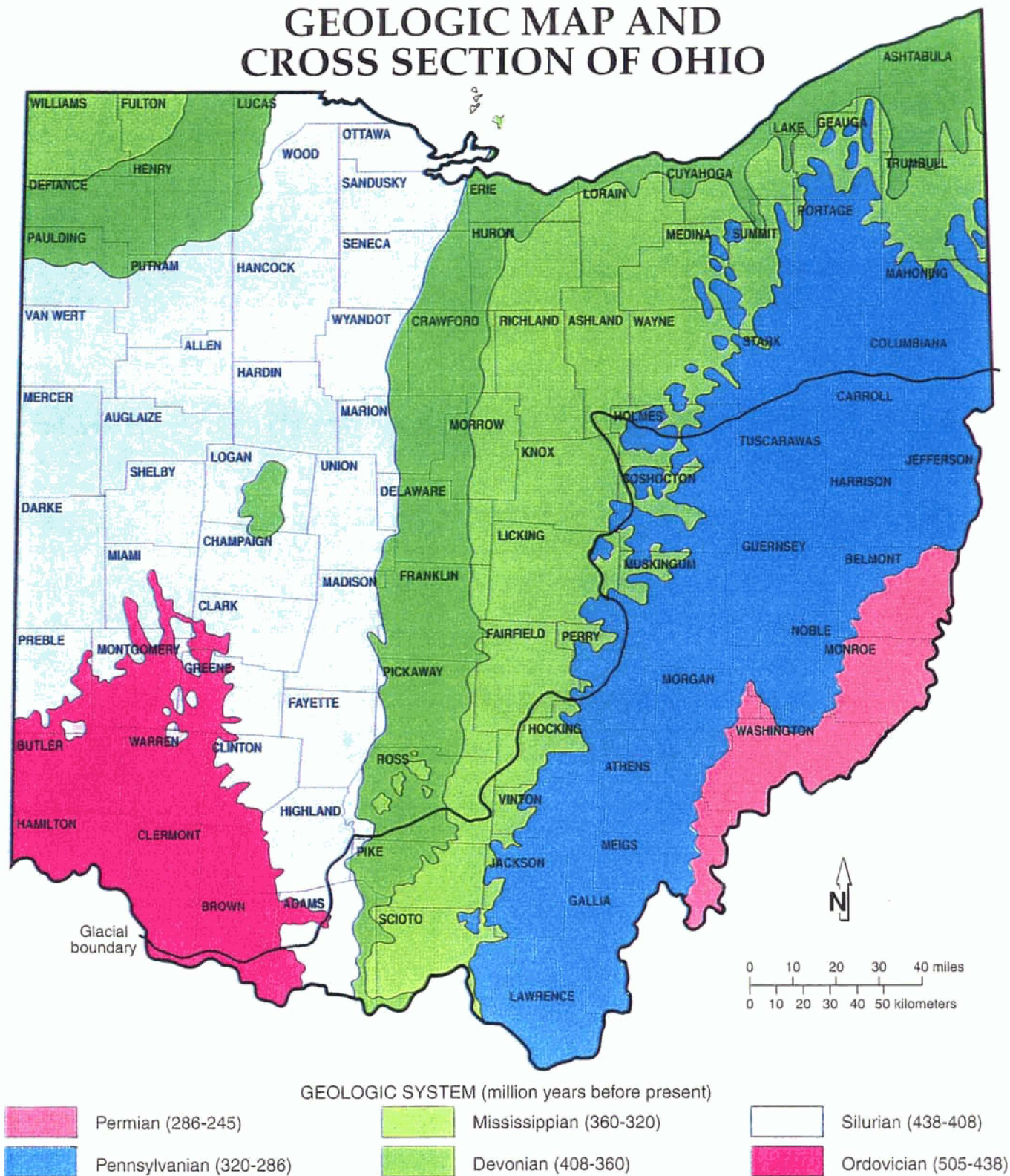


Figure 2

Bedrock geologic map and cross section of Ohio
(Ohio Geological Survey, 1995)

Legend:

- Kames and eskers
- Outwash
- Lake deposits
- WISCONSINAN (14,000 to 24,000 years old)
 - Ground moraine
 - End moraine
- ILLINOIAN (130,000 to 300,000 years old)
 - Undifferentiated morainic drift
- PRE-ILLINOIAN (older than 300,000 years)
 - Undifferentiated morainic drift

5

glacial event on record to give evidence in Ohio is the Kansan. Two other glacial events that made their mark on Franklin County were the Illinoian and the Wisconsinan. The latter two provided the glacial landscape for most of Ohio.

Kansan (Pre-Illinoian) Glaciation

The original glacial deposits of the Kansan have been worked over by other glaciers since the end of the Kansan over 300,000 years ago. The glacier originally left its sediment in the northern part of Ohio, spanning from the bordering state of Pennsylvania to the southwest corner of Ohio. The only substantial surficial drift of this age found today is located in the southwest corner of Ohio.

The Kansan did leave its mark on the state with glacial carving of the rock and changes in the drainage. The major river system of the region before the Kansan events occurred was the Teays. The northward flowing Teays River was stopped due to the advance of Kansan ice. A large lake named Lake Tight was formed as a result. The lake deposits (Figure 3) in eastern Scioto County are from this lake. The lake was named after William G. Tight, the first geologist to study the Teays system (Hansen, 1997). A new stream system was introduced in central Ohio when the water level exceeded the boundaries of Lake Tight and other ice marginal lakes. Along with new streams being created old streams changed in many ways. Some ceased to exist while others moved laterally or even reversed flow directions (Stout et al., 1943). The Teays system can be seen in the southeast corner of the state in non-glaciated regions. The Teays can also be found in the glaciated portion of Ohio but it is in the form of buried valleys cut into the bedrock and filled with till and other sediment.

Illinoian Glaciation

The Illinoian event had a major effect on the central region of Ohio as well as the southwestern region. The destruction of stream systems as the glaciers moved across the area and the glacial deposition changed the landscape significantly. The most important result of the event was the glacial drift that blanketed the area filling depressions in the topography and building end and ground moraines. This deposition had an effect on the stream systems as well (Stout et al., 1943).

The compacted unsorted Illinoian drift is referred to as being a gummy till (Stout *et al.*, 1943). Due to oxidation it is yellow-brown in color. The till can be gray-blue in color but only in the deeper parts of the thicker sections that are greater than the average thickness of the till which is 25 feet. It contains very few large boulders and the beds of sand and or gravel are sparse and small in volume (Stout *et al.*, 1943).

Wisconsinan Glaciation

The Wisconsinan Glacier was the youngest of the glaciers to have traversed the state of Ohio. The event has been recorded as two major movements. The first movement occurring over 50,000 years ago and the later movement around 22,000 years ago (Goldthwait, 1958). This latest event did not advance as far as the Illinoian (Figure 3). The effects of the event were similar to the Illinoian glaciation with smoothing of the landscape and forming of end moraines and mounds in the affected area. The Wisconsinan flow eroded and incorporated most of the Illinoian drift but some Illinoian

till, and sand and gravel deposits can be found in valleys where it could be protected or in areas that the Wisconsin ice did not cover (McLoda and Parkinson, 1976).

Wisconsinan till found in the northwest part of the County has less lime in it than the till which is found in the southeast part of the glacially effected portion of the state. The bedrock of the area northwest of the county consists mostly of limestone, and this is reflected in the composition of the tills and outwash deposits (Baker, 1966). Ice flow was to the south in the western part of the county and east in the eastern part as indicated by the shape of the Wisconsinan end moraines (Figure 3). Topography of the bedrock suggests that the glacier moved south southeasterly, controlled in part by the bedrock (Figure 4). A general description of the glacial material is that it is yellow-brown in color where it has been weathered. It has clay, silt, sand and gravel of various sizes and roundness (Stout et al., 1943).

The new glacial map of Ohio provides more detail on the surficial geology of Franklin County (Pavey et al., 1999). A portion of this map is shown in Figure 5 and records the following units. **G2** Ground moraine, flat to gently undulating. **G2b** Same as **G2** but has high concentrations of surface boulders. **O3** Low-level valley-train outwash; formed between 15 and 14 kA; sand and gravel; contains small areas of peat. **M2** End moraine, as hummocky ridges higher than adjacent terrain. **K** Kames and kame terraces, sand and gravel, poorly sorted and bedded, contains some boulders and till masses. **L3** Lake-planed moraine, very flat, planed by waves in glacial lakes; small patches of sand, silt, clay on the surface in many areas. **a** Alluvium and alluvial terraces, deposited in present and former floodplains; ranges from silty clay in areas of fine-grained deposits to coarse sand, gravel, or cobbles in areas of shallow bedrock.

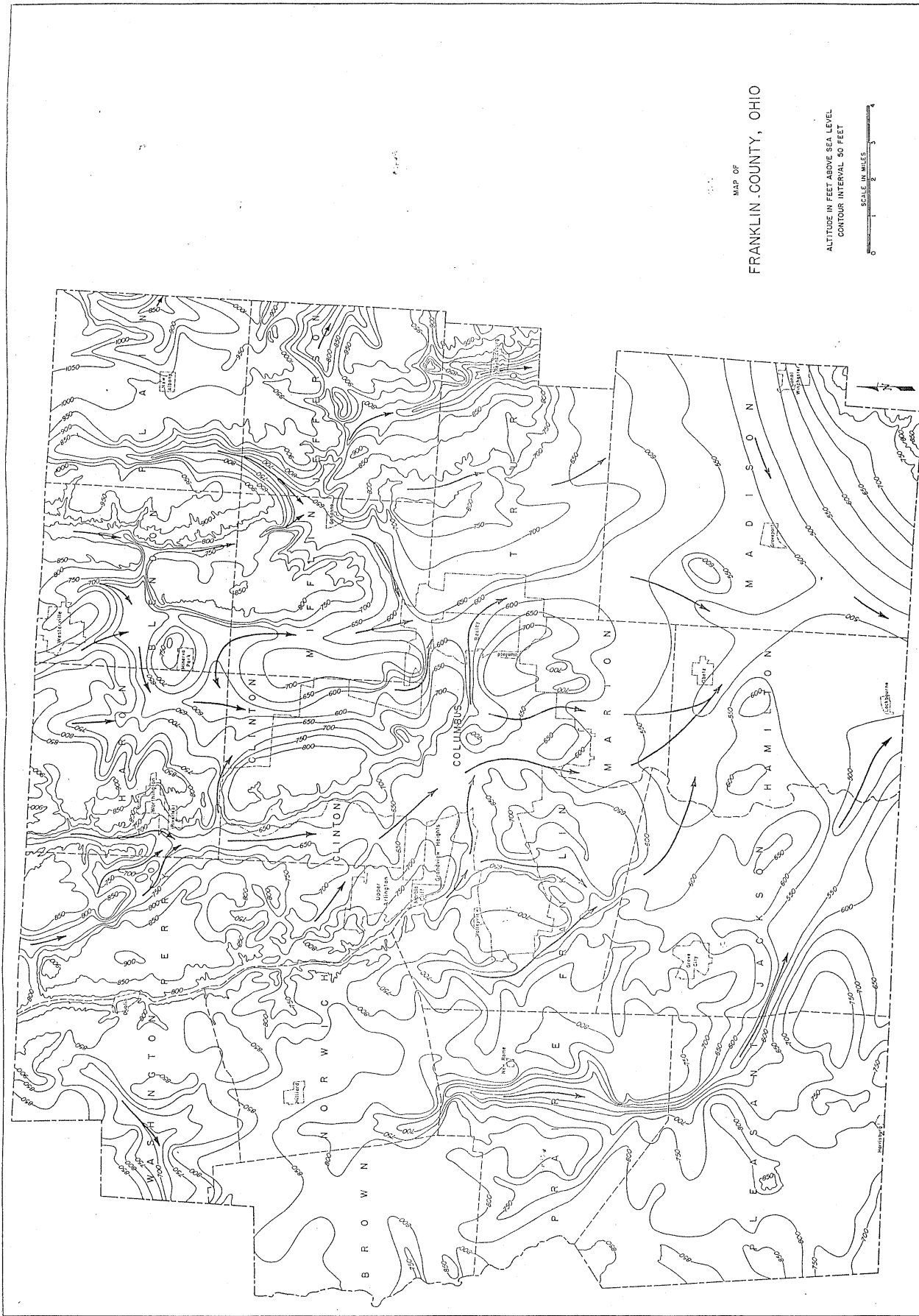


Figure 4 Bedrock topography and flow directions of pre-glacial and glacial rivers and streams (from Schmidt and Goldthwait, 1958)

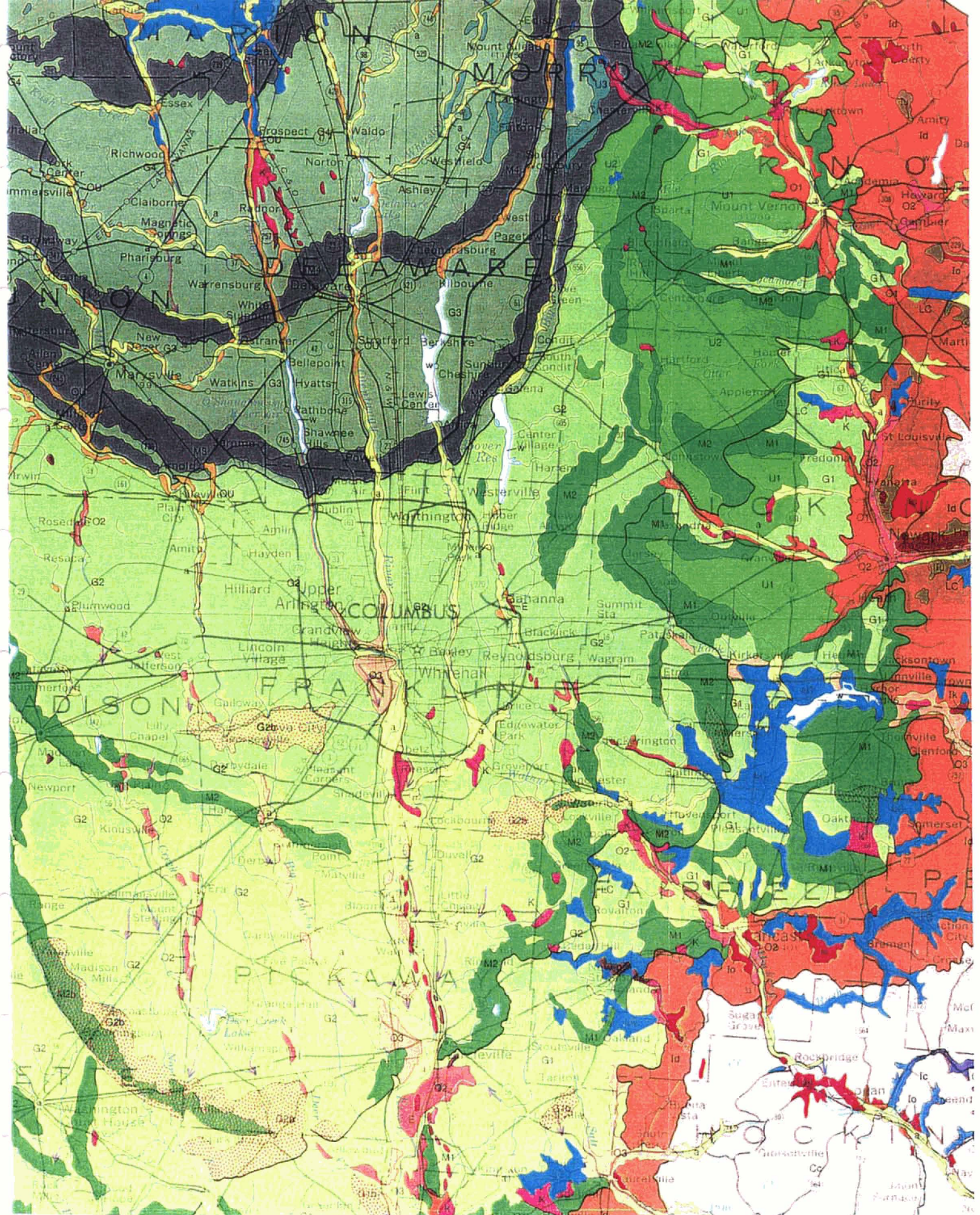


Figure 5 Glacial geology map of Franklin County and adjacent area
(from Pavey et al., 1999)

Paleozoic

Geologic History

The bedrock of Franklin County is mostly limestone and shale, with limestone being the dominant rock found under the campus area (Figure 6). The bedrock was deposited through marine sedimentary processes in the Devonian (Hansen, 1999). No record of the Mesozoic history of Ohio exists except that erosion or deposition followed by erosion had occurred. As a result of preglacial fluvial erosion valleys were formed in the Devonian bedrock.

During the Devonian, Epicontinental seas covered the United States including Ohio. The Ohio Shale was formed during the Devonian in a stagnant sea. The materials that compose the Ohio shale have been traced to have been deposited at the sea bottom from the erosion of mountains that created the Catskill delta (Hansen, 1997). The OSU campus is underlain by both shale and limestone, with the contact generally east of the Olentangy river. Shale is exposed in ravines east of High Street; limestone is exposed in quarries along the Scioto river.

Columbus Limestone

The formation is 105 feet approximately in thickness and consists of limestone as well as dolomite (limy). The first 65 feet from the top is bluish gray, crystalline fossiliferous limestone. The last 40 feet of the formation is known to be “a porous, massive brown, limy dolomite that contains an abundance of bituminous crystalline bluish, fossiliferous limestone.” There is a “chert zone” that can be found around 55 to 65 feet in depth (Baker, 1966, p12).



EXPLANATION

LOWER CUYAHOGA FORMATION
Series of alternating layers of sandy shale and sandstone. Ample water supplies are available for farm, domestic, and small industrial use. Potential yields of as much as 30 gpm may be expected from the sandstone layers.

SUNBURY SHALE
This argillaceous shale is not considered to be a reliable source of ground water.

BEREA SANDSTONE
Thin to massively bedded sandstone ranging from 5 to 55 feet thick. Yields of as much as 25 gpm may be obtained in Madison, Plain, and Jefferson Townships.

BEDFORD SHALE
Soft argillaceous shale, 1 to 2 feet thick. Very poor source of ground water in Franklin County.

OHIO AND/OR OLENTANGY SHALE
Carbedonaceous shale, 1 to 2 feet thick. Not a dependable source of ground water in the county. Generally yields less than 2 gpm.

DELAWARE AND/OR COLUMBUS LIMESTONE
The Delaware formation is a thin to massively bedded dense limestone, with some thin shaly layers. Yields of less than 3 gpm may be expected from the Delaware. The Columbus limestone is a massive bedrock aquifer in the western half of Franklin County. Industrial supplies may be developed, however, relatively high hardness, dissolved solids, and hydrogen sulfide may be characteristic of water from deep wells.

BASS ISLANDS DOLOMITE
The Bass Islands dolomite is exposed in Pleasant Township and crops out beneath thick glacial fill in the northern half of Franklin County. It is a thin bedded limestone bedrock aquifer in the county and has a potential yield of up to 400 gallons a minute. As with other limestone aquifers in the county, the degree of mineralization increases with depth.

MAP OF
THE CONSOLIDATED ROCK UNITS IN
FRANKLIN COUNTY, OHIO
WITH DESCRIPTION OF THEIR WATER-BEARING PROPERTIES
AND SHOWING CONTOURS ON THE BEDROCK SURFACE

ALTITUDE IN FEET ABOVE SEA LEVEL
CONTOUR INTERVAL 50 FEET

SCALE IN MILES

Figure 6
Bedrock geologic map of Franklin County
(from Schmidt and Goldthwait, 1958)

This limestone has been found to contain caverns where ground water traveling along joints has opened holes or caverns in sections of the limestone (Baker, 1966). When attempting to drill a hole to install an earthquake detection device at a site behind Mendenhall Laboratory on the OSU campus, drillers encountered these caverns. A rotary drill was used which breaks up the material as it progresses down. An earlier test hole, only 25 feet from the actual well, revealed no evidence of the cavern. The Columbus limestone is considered to be economically valuable for mining despite the possibility of the caverns disrupting the efforts of construction.

Delaware Formation

On top of the Columbus Limestone is the Delaware formation consisting of another bed of limestone with layers of shale and chert. (Baker, 1966). There is a layer of fish remains that have been fossilized which helps to distinguish the boundary of the Delaware and the Columbus. The other feature that distinguishes them is the change from pure limestone to the shaley cherty rock of the Delaware. The average thickness of the formation is approximately 32 feet. The color of the formation is from brown-gray to blue-gray. The bottom 10 feet of the Delaware formation is limestone. This limestone is often quarried with the underlying Columbus limestone. The Delaware is overlain by the Ohio and Olentangy Shale.

Ohio and Olentangy Shale

The Olentangy Shale overlies the Ohio Shale and is blue-gray to green-gray in color. It is soft shale that weathers into blue clay. There are thin layers of limestone; pyrite may be present in the formation. It is a bad source for groundwater.

The Ohio Shale is brown to bluish black. It is considered to be a formation that ranges from a massive appearance to thinly laminated. Pyrite is readily abundant within this shale. It is also the top oil-bearing shale for all of Ohio. It is not considered a good source for groundwater. The Ohio and Olentangy shales are 40% of the bedrock in Franklin County. Concretions, used as lawn decoration, are the most common resource from the shale.

UNCONSOLIDATED MATERIALS OF THE OSU CAMPUS

Glacial and Post-glacial deposits

When considering Ohio's unconsolidated material it can be divided into two types. One type being the residual clays that have been around since before the glacial events. These are buried beneath glacial deposits at OSU. The other type of material was left by the glacial and post-glacial events. Franklin County was completely passed over by the ice sheets and the unconsolidated material represented is almost completely glacial or post-glacial in origin (Figure 7). This section focuses on the soils of the OSU campus. In the area of OSU, the main units shown on Figure 7 are ground moraine, valley-train deposits (or outwash) and alluvial deposits. No data on the mineralogy, grain-size distribution or engineering characteristics of the deeper parts of till units were found.



Figure 7

Glacial and alluvial deposits map of Franklin Coun
(from Schmidt and Goldthwait, 1958)

SCALE IN MILES
0 1 2 3

EXPLANATION

ALLUVIAL DEPOSITS

Silt and gravel deposited by the present streams on their flood plains. Because these deposits are thin and generally impermeable, they are not a source of ground water. Wells that penetrate the deposits may encounter valley-train deposits, and tapping ground-water supplies.

VALLEY-TRAIN DEPOSITS

Outwash deposits of sand and gravel deposited in the valleys by flooding meltwater from the glacier. These deposits occur above present drainage as gravel terraces and generally do not recharge infiltration from major streams. These deposits have some recharge potential for the underlying formations, which usually consist of valley-train deposits below drainage.

KAMES AND ESKERS

Sand and gravel deposited as hills and ridges. Some of these are covered with thin till or conglomerate. The quantity of water obtainable depends upon the thickness of the material and amount of recharge.

END MORANE

Generally till in places stony or sandy, with interbedded sand and gravel lenses. Deposited as hills and ridges at the edge of the glacier. Small farm and domestic water supplies are generally developed from wells in the lenses of sand and gravel.

GROUND MORANE

Till generally more than 20 feet thick, although bedrock may be exposed in a few places. Meager water supplies in the till, but adequate supplies for farm and domestic use are sometimes developed in the thin lenses of sand and gravel interbedded in the till.

LAKE BEDS

Clay and silt which settled in small lakes near the melting ice edge. These deposits range from 10 to 20 feet thick and are not a source of ground water.

Drainage Channels

Gravel Pit

Soils of The Ohio State University Campus

The soil material is described in the order it is encountered from west to east corresponding to the cross section line A to A` of Figure 8. The letters listed at the end of the title for each soil correspond to those found on figure 8 which is a photograph of The Ohio State University campus area (McLoda and Parkinson, 1977). The photograph contains outlined boundaries of the soils for the area.

The descriptions of the soil can be interpreted as follows. Silt sand clay loam is a layer consisting of clay with silt and sand in it. Clay is the substantial material. When a soil is named Urban a certain percent of the area has been covered by urban development such as pavement or buildings. The exposed soil will be described with a percentage given for the urban area. The descriptions are from the Franklin County Soil report and are in abbreviated form that may not include sentences (USDA, 1977)

Crosby-Urban land complex 2-6 percent slope. (CsB)

The area consists of 45% Crosby silt loam and 30% Urban land. Crosby has an upper portion of 9 inches that is composed of silt loam and is gray-brown in color. Underneath this layer is 26 inches of mottled brown silty clay loam with mottled yellow-brown firm clay. High potential frost action and a slow permeability. Commonly utilized for parks, open space, lawns and gardens. Not rated good for most building site development. This is due to its low permeability, low strength and seasonal wetness. This poor building status can be solved with precautions. Drainage away from foundations would be necessary along with other considerations. It is considered okay for recreational uses.

1:850,000 FEET

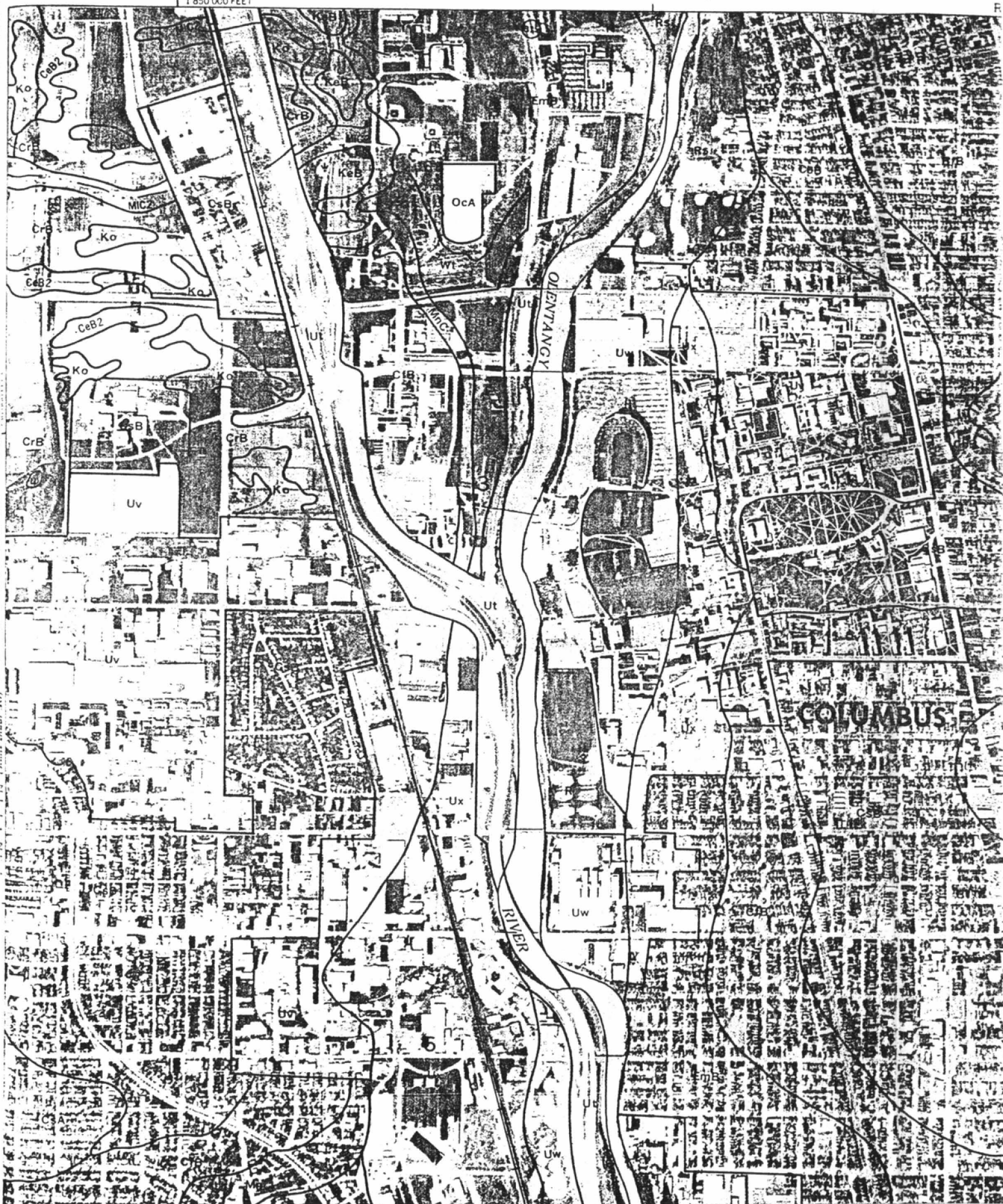


Figure 8 Soils map of the OSU campus
(from McLoda and Parkinson, 1976)

Crosby silt loam, 2-6% slopes. (CrB)

The 9 inches of surface layer consist of silt loam that is dark gray brown in color. The 16 inches of subsoil has an upper layer of firm silt clay loam and clay loam brown and mottled, dark yellow brown in color. The lower section is firm clay loam that is mottled and yellow brown in color. The 70 inches of substratum is composed of mottled yellow brown glacial till described as firm clay loam and loam. The permeability is rated slow. The subsoil has moderate available water capacity. This subsoil also has moderate shrink swell potential and organic content. Frost action potential is high. A good area for farming. The building site development potential and sanitary facilities are considered low. Recreational uses are described as medium.

Kokomo silty clay loam. (Ko)

The 9 inches of surface layer is silt clay loam that is very dark gray in color. The 16 inches of subsurface layer is silt clay loam very dark gray in color. The 27 inches of subsoil is divided into two sections. The upper consists of firm silt clay the lower section is mottled silt clay loam and clay. The upper and lower sections are both dark gray in color. The 70 inches of substratum consists of glacial till. The firm clay loam and loam is mottled and brown yellow brown in color. It is considered to have moderately slow permeability. The available water capacity is high. The subsoil potential of shrink swell is moderate. Frost action and organic content is considered high. Slow runoff is associated with the soil. This soil is subject to flooding.

Udorthents-Urban land complex, gently rolling. (Ut)

The area consists of 50% Udorthents and 40% pavement. The average slope is 2-12%. In areas where the subsurface is exposed the soil is similar to that of the surrounding soil. Generally it can be described as a mixture of the subsoil and substratum of the bordering soils. The organic content is considered low and the water capacity is variable.

Celina-Urban land complex, 2-6% slopes. (CfB)

The 8-inch layer at the surface is silt loam and brown in color. The 20-inch subsoil is divided into two layers. The upper layer is silt clay loam brown in color. The lower section is firm silt clay loam and clay that is mottled and brown in color. The 70-inch substratum is described as yellow brown glacial till, brown mottled firm clay loam and brown mottled firm loam. The permeability is described as moderately slow. It has an available water capacity. Shrink swell factor is a potential in the subsoil. The frost action is considered high. The organic capacity of the soil is moderate. It is considered to be medium for building site development soil and low for sanitary facilities.

Described as good for recreational uses with a high rating.

Miamian-Urban land complex, 6-12% slopes. (MnC)

The area consists of 45% Miamian silt loam and 30% Urban land. The top 9 inches of soil is silt loam that is brown in color. The next 36 inches of subsoil is composed of firm clay and firm clay loam brown and yellow-brown in color. Miamian has a moderately slow permeability rating. The shrink swell, frost action and water capacity is considered moderate. The organic content of the soil is moderately low. Runoff is fast. The Miamian is considered medium potential for building site

construction, sanitary facilities and recreational use. The soil is good for grasses to trees but is considered to be an erosion hazard when the soil is exposed or disturbed.

Eldean-Urban land complex 2-6% slopes. (EmB)

The area consists of 45% Eldean silt loam and 30% Urban land. The surface of the Eldean is a layer 9 inches thick of silt loam that is brown in color. The subsoil below is 19 inches thick and is divided into the upper and lower sections. Upper section is firm to very firm clay loam that is reddish brown and brown. The lower section is very firm clay and gravelly clay loam. The substratum is 70 inches thick of loose layered gravelly sand. The permeability is considered moderate in the subsoil and fast in the substratum. Organic content is found at a moderate level. Moderate to low water capacity in the Eldean. Low frost-action and moderate shrink-swell factor. It has a high potential for building site development as well as recreational use. It is also good for growing grasses trees etc. There is no mention of crop growing.

Ross silt loam occasionally flooded. (Rs)

Ross silt loam has an upper layer of silt loam 11 inches thick that is dark gray brown in color. Lying below the upper layer is silt loam 5 inches thick and very dark brown in color. Below that is 24 inches of subsoil. The upper section is silty loam that is very dark gray and very dark gray brown. The lower section is silt loam and silt clay loam that is dark yellow-brown and brown in color. The last section of soil is the substratum with a thickness of 70 inches mottled in the lower portions and dark yellow-brown to yellow brown in color. Permeability is considered moderate. It has a high water capacity as well as being high in organic matter and fertility. Low shrink-swell

factor is associated with the soil. There is a slow run off and the subsoil is considered somewhat acidic to mildly alkaline. Not a good building site soil due to flooding

Urban land-Genesee complex occasionally flooded. (Uw)

The Genesee soil has an upper layer of 9 inches consisting of silt loam that is mottled and brown in color. The next 22 inches is composed of silt loam and clay loam that is brown and yellow-brown in color. The remaining 70 inches is loam that is yellow in color and gravelly sand loam that is mottled and brown in color. Considered to have moderate permeability and frost action. It has a large water capacity and moderate organic content. It has a slow runoff and is slightly acidic or alkaline in its subsurface. Rated low for building site conditions and considered to be good for lawns, gardens and open spaces. Its recreation uses are low.

Urban land-Ockley complex, 0 to 6% slopes. (Ux)

The area consists of 65% Urban land and 15% Ockley soil. The Ockley soil top layer is 8 inches thick. It is composed of silt loam that is brown in color. The subsurface is six inches of silt loam that is brown in color. The subsoil is 38 inches in thickness. The red-brown upper and middle sections are firm clay loam. The lower section is dark red-brown gravel sand clay loam. The substratum consists of 70 inches of loose gravel loam sand. Ockley soil is considered to have moderate permeability in its subsoil and very good in the substratum. Shrink-swell organic content and frost action is moderate. The water capacity of the soil is moderate to high. A high potential for building site

development and recreational use is associated with this soil. Good for grasses to trees.

Erosion is not considered an important factor for consideration.

Urban land-Celina complex, 2-12% slopes. (Uv)

The 7 inches of surface layer consists of silt loam and is brown in color. The 18 inches of subsoil is divided into two sections. The upper section is silt clay loam yellow brown in color. The lower section is firm clay and clay loam mottled and dark yellow brown in color. The substratum is firm loam mottled, brown in color and 70 inches thick. The permeability is described as moderately slow with regards to the subsoil and substratum. The water capacity is moderate. The shrink swell potential is moderate. The frost action is considered high. Medium to fast runoff. Potential as a building site and recreation use is medium. Potential is medium for sanitary facilities.

HYDROGEOLOGY OF THE OSU CAMPUS

Groundwater in the Consolidated Rocks

The Columbus limestone is considered to be the source for domestic, farms and smaller industrial use. The Delaware formation is not as good of a source as the Columbus. The reasons for this can be explained. The ability of consolidated rock to be a good source of groundwater can depend on the properties of the rock itself. The permeability of the rock is a major concern. How the rock has been altered can also be

considered a major concern. If the rock has lots of fractures and joints its ability to be a groundwater resource is increased. The combined gallons per minute that can be taken from the Columbus limestone and the Delaware formation together is 175 gpm. The Olentangy and Ohio shales allow for 3 gpm to be taken from them. The shales are typically by nature not good groundwater resources.

Groundwater in Surficial Aquifers

Outwash gravels in the Olentangy valley contain significant quantities of groundwater. Typically, outwash in Franklin County is considered to be a good aquifer.

STRATIGRAPHY OF THE SURFICIAL DEPOSITS OF THE OSU CAMPUS

The stratigraphy of Franklin County is divided into four major units, Quaternary, Mississippian, Devonian, and Silurian (Figure 9). The youngest unit, the Till Clay unit, has some lenses and interbed sand and gravel. The Mississippian age unit that underlies the Till Clay unit depicts shale as the predominant rock with some sandstone present. Underlying the Mississippian age unit is the Devonian age unit composed of shale and limestone. The general dip of the bedrock is east. The B - B' cross section is closest in proximity to the OSU campus on Figure 9. Cross section B - B' shows the Devonian shale and limestone contact near the river as is the case of the OSU campus. The bottom unit included on the cross sections is the Silurian age dolomite, which is not exposed near the OSU campus. They all exhibit a good representation of the glacial valleys carved out

of the bedrock and the unconsolidated material filling in the valleys smoothing the surface.

I prepared two cross sections of the OSU campus using data taken from various drill hole logs of campus buildings that lie on either the A - A' or B - B' cross section lines (Figures 10). These data was found at the Office of the University Architect and Physical Planning (4th floor, Central Classroom Building, 2009 Milliken Road on the OSU campus).

The east-west cross section (Figure 11) does not have much data that extends to the bedrock but it does give representation of the different assortments of clay, sand, and gravel (probably till) that can be found in the campus area. All holes begin with a layer of clay but beyond that most of the wells differ in the underlying units. Some holes have clay as the dominant material from top to bottom while others indicate boulders are present in a matrix of sand with very trace amounts of silty clay particles, and yet other holes fall somewhere in between.

Similar to the east-west cross section the north-south cross section (Figure 12) holes all begin with a layer of clay with the exception of the Ice Rink data which indicates that a crushed rock fill was put in place during the construction of the facility. Directly below that fill is a layer of clay that has a description that matches those of the surface clay layers in the other holes. The material found below this upper clay layer differs greatly across the section. The north-south-cross section has all holes indicating the depth to bedrock with exception of the data for Dodd Hall. The bedrock is limestone with some data indicating chert being present.

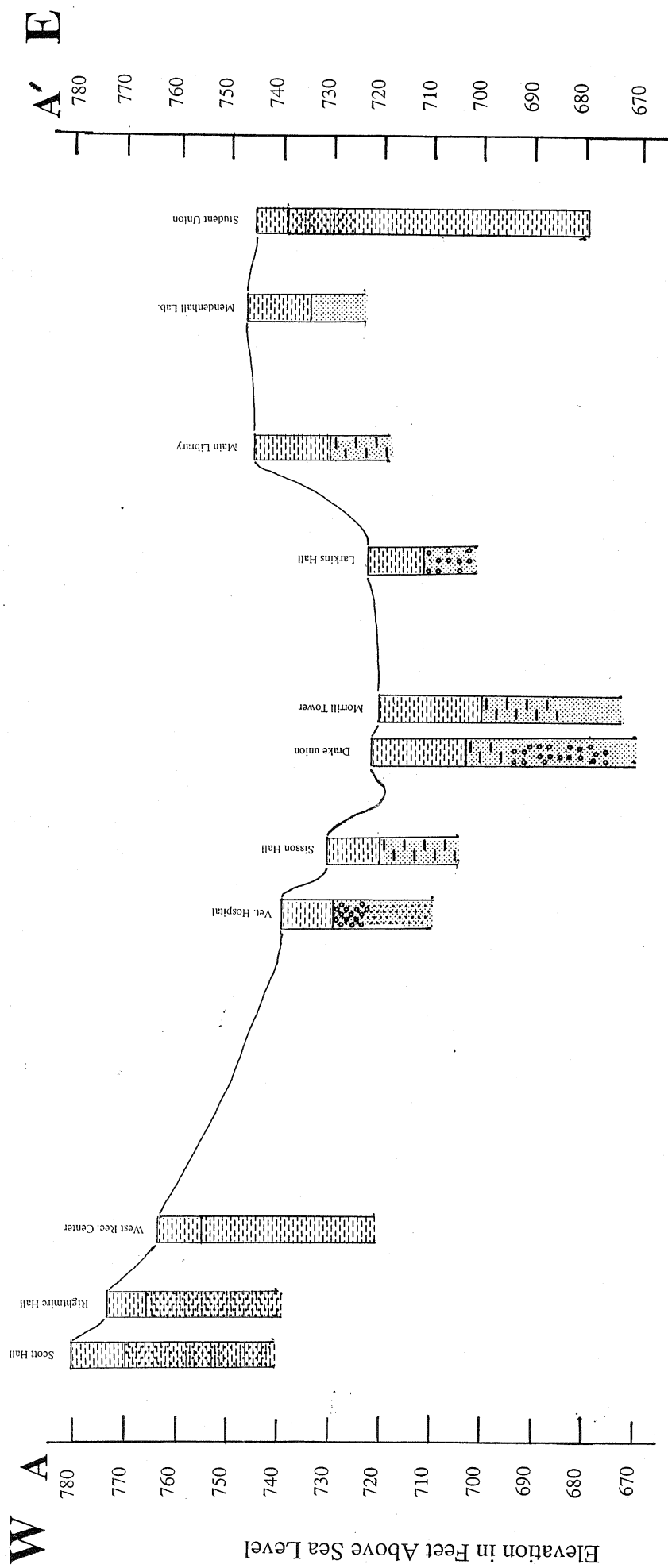


Figure 11 East-West cross section, OSU Campus

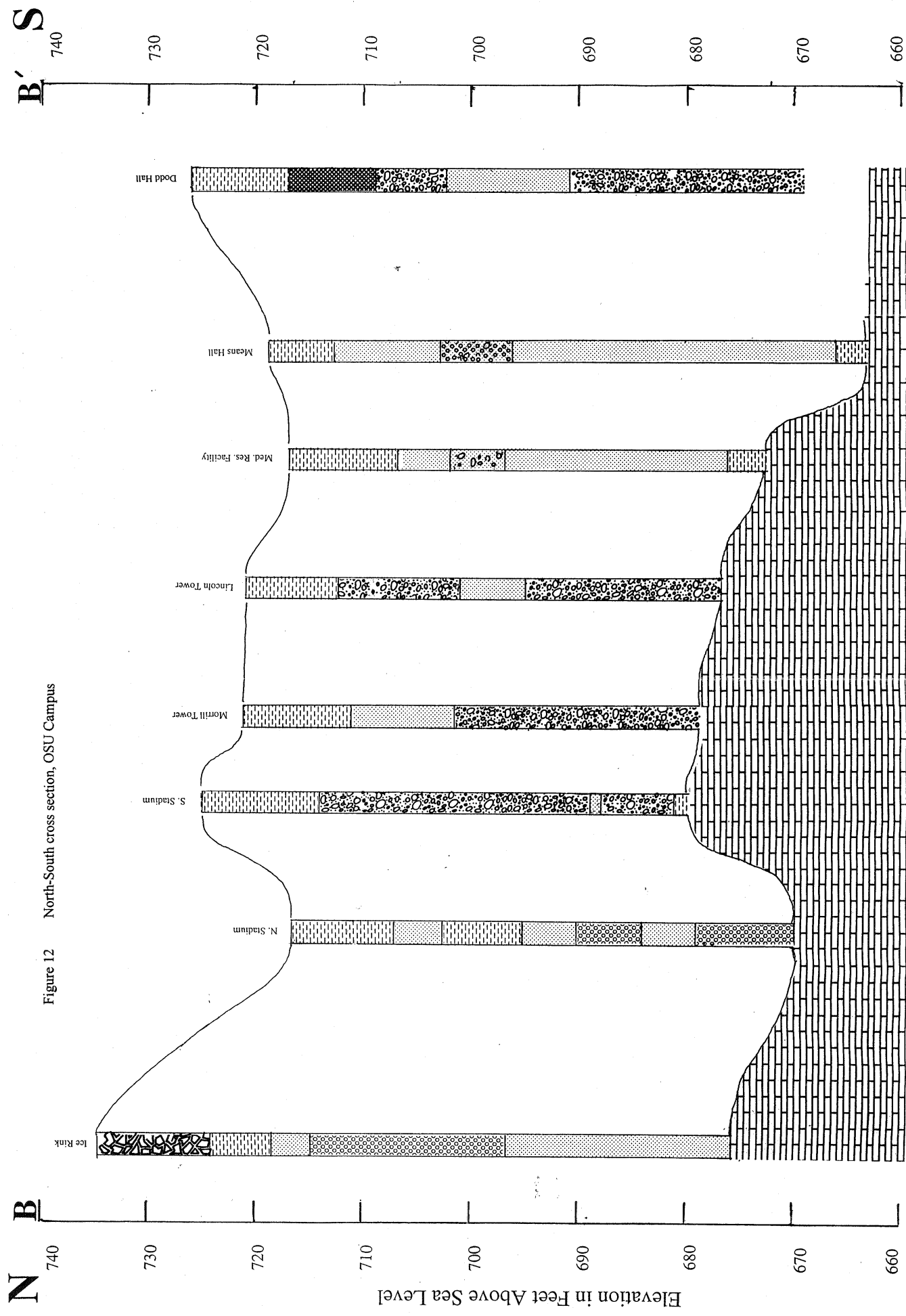
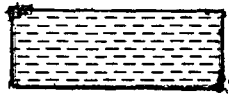


Figure 12 North-South cross section, OSU Campus

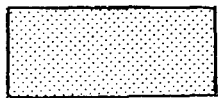
OSU Campus Cross Sections A-A' and B-B'

Explanation

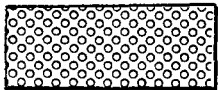
Unconsolidated Rock



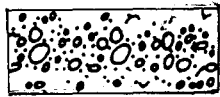
Clay



Sand



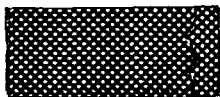
Gravel



Clay sand Gravel



Fill (Crushed Limestone)



Organic Material

Consolidated Rock



Limestone

Figure 13 Campus cross section explanation of symbols

CONCLUSION

The OSU campus has an interesting and diverse subsurface. There are lots of sources for information on Franklin County and the State of Ohio. The information collected pertaining to the materials of the campus subsurface can be related to the information on the geologic history of the region. OSU campus drill hole data did not result in corresponding layered stratigraphy between the surface and the bedrock. This indicates a glacial deposition. Adding to the evidence are beds of sand and gravel that are intermittent and indicate possible outwash deposition. To apply a general stratigraphic correlation it could be noted that the deposits follow the pattern of till gravel till.

There is more work to be done by way of depth to bedrock for all of the campus including west campus. Work could also be done to create a groundwater flow system of the campus including; an in depth description of the properties of the surficial aquifers and the bedrock, a depth to water table and a directional flow diagram. This could help with future construction projects as well as possible contaminant remediation.

References

- Baker, F.J. 1996. Physical Studies of Franklin County: Comprehensive Regional Plan - - Columbus and Franklin County. Project X-301.
- Brockman, C.S. Physiographic, Regions of Ohio, Map. Department of Natural Resources And Division of Geological Survey, 1998.
- Feldman, R.F., and Hackathorn, M. (Eds.). Fossils of Ohio. Ohio Division of Geologic Survey, Bulletin No. 70, 1996
- Geologic Map and Cross Section of Ohio. Map. Department of Natural Resources and Division of Geological Survey, 1998.
- Glacial Deposits of Ohio. 1997 Map Department of Natural Resources and Division of Geological Survey.
- Hansen, M.C. 1997 "The Geology of Ohio – The Devonian." Ohio Geology. Fall.
- Hansen, M.C. 1997 The Ice Age in Ohio. Educational Leaflet No. 7, Division of Geological Survey.
- Hansen, M.C. 1997 "The Geology of Ohio – The Ordovician." Ohio Geology. Fall.
- Hansen, M.C. "Ohio Shale Concretions. Geofacts. No. 4. Ohio Department of Natural Resources and Division of Geological Survey, 1994.
- Hubbard, G.D., Stauffer, C.R., Bownocker, J.A., Prosser, C.S., and Cummings, G.R. Geologic Atlas of The United States. Department of the Interior, United States Geological Survey, 1915.

McLoda, N.A. and Parkinson, R.J. Soil Survey of Franklin County, Ohio. United States

Department of Agriculture, Soil Conservation Service, in Cooperation with

Ohio Department of Natural Resources, Division of Lands and soil, and

Ohio Agricultural Research and Development center, 1976.

Pavey, R.R., Goldthwait, R.P., Brockman, C.S., Hull, D.N., Mac Swinford, E., and

And Van Horn, R.G. Quaternary Geology of Ohio. Ohio Division of Geological

Survey, Map No.2, 1999.

Schmidt, J.J., and Goldthwait, R.P. The Ground-water Resources of Franklin County,

Ohio. State of Ohio Department of Natural Resources and Division of Water,

Bulletin No.30, 1958.

Stout, W., Ver Steeg, K., and Lamb, G.F. 1943, Geological Survey of Ohio, 4th Series,

Bulletin No 44.